Indian Journal of Health Care, Medical & Pharmacy Practice (Vol 7, Issue 1, Jan-June 2026)
Home page of the journal: https://ijhmp.com/Home

Research Article

UNLOCKING EARLY DIAGNOSIS OF NEONATAL SEPIS THROUGH HAEMATOLOGICAL SCORING SYSTEM

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DOI: https://doi.org/10.59551/IJHMP/25832069/2026.7.1.136

How to cite this article: Singh A, Gupta K, Mohan A et al., Unlocking Early Diagnosis of Neonatal Sepis through Haematological Scoring System. *Indian J. Health Care, Med. Pharm. Pract.* 2026;7(1):292-300.

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Received: 10 May, 2026, Decision for Acceptance: 12 June, 2026

ABSTRACT

Introduction: Neonatal sepsis remains a formidable global health challenge, constituting a significant cause of morbidity and mortality among both term and preterm infants. Our study was aimed to evaluate the importance of haematological scoring system for the early diagnosis of neonatal sepsis.

Material and Methods: Hospital-based prospective observational study was conducted over 18 months, involving 100 neonates with suspected sepsis using convenience sampling. Inclusion criteria involved neonates under 28 days old with clinical suspicion of sepsis and guardian giving informed consent. Data collected included maternal, perinatal, and neonatal clinical profiles, and haematological investigations like WBC, ANC, I/T ratio, platelet count, CRP, and blood culture using the BACTEC system. Rodwell's haematological scoring system was employed to assess sepsis likelihood.

Results: In our study, 91% of neonates were in the early neonatal period (1–10 days), with a slight male predominance (54%). Poor feeding (66%) were the most common clinical presentation. Using Rodwell's haematological scoring, 34% were classified as "sepsis very likely," 31% as "possible sepsis," and 35% as "sepsis unlikely." CRP was positive in 78% of cases and blood culture in 52%, both showing significant association with sepsis likelihood. Platelet count, immature PMN count, and I/T ratio showed significant variation across sepsis categories.

Conclusion: Our study highlights the usefulness of Rodwell's haematological scoring system as a cost-effective and practical tool in the early diagnosis of neonatal sepsis.

KEYWORDS: Haematological Scoring System, Infections, Peripheral Blood Smears, Total Leukocyte Count.

Introduction

Neonatal sepsis accounts for approximately 8% of all neonatal deaths worldwide within the first week of life and nearly 37% of deaths occurring between the second and fourth weeks of life, underscoring its substantial burden during the neonatal period[1]. In India, the reported incidence of culture-confirmed neonatal sepsis is around 16 per 1000 live births in hospital-based data, while community-based studies from rural regions indicate a comparatively lower incidence of 4 per 1000 live births[2]. However, population-based data from across the nation reflect considerable variability in the rates of clinically suspected sepsis, with figures ranging from as low as 4.6 to as high as 170 per 1000 live births. This disparity can be attributed to differences in healthcare access, and diagnostic capabilities[3].

Traditional microbiological culture remains the gold standard for diagnosing neonatal sepsis[4]. However, its

utility is limited in acute care due to the time required to definitive results . Furthermore, prior antibiotic exposure, and inadequate sample volumes can compromise the sensitivity of blood cultures, leading to false-negative results[4]. In this context, clinicians increasingly rely on adjunctive diagnostic tools such as the Haematological Scoring System (HSS) to aid in early identification of suspected sepsis[4]. HSS includes various parameters which show changes during the sepsis[4].

Originally, Monroe proposed a simplified hematological model utilizing three key parameters: total polymorphonuclear (PMN) count, immature PMN count, and the immature-to-total neutrophil (I:T) ratio[5]. While informative, these indicators alone often lack the sensitivity required for early diagnosis[6]. In contrast, the comprehensive Haematological Scoring System developed by Rodwell et al. offers a more structured approach, evaluating seven distinct haematological parameters[6]. These include total leukocyte count, total polymorph count, immature polymorph count, immature to total neutrophil (I:T)ratio, immature-to-mature neutrophil (I:M) ratio, platelet count, and the presence of degenerative changes in neutrophils[6]. Each parameter is scored as either normal (score of 0) or abnormal (score of 1 or 2), depending on its deviation from established neonatal reference ranges[6]. A cumulative score of less than 2 is suggestive of a low probability of sepsis, while a score of 5 or more strongly indicates an infectious process[6].

The strength of HSS lies in its simplicity, cost-effectiveness, and availability in most clinical settings, making it an valuable tool in resource-constrained environments[7]. Unlike culture-based diagnostics, the HSS can be implemented rapidly using basic haematology data obtained from routine complete blood counts (CBCs)[7,8].

This study was done to evaluate the role of haematological scoring system to early diagnose the neonatal sepsis. It strengthens the neonatal protocols and trains health care professionals in its interpretation[7,8].

Aim and Objectives

Aim

To evaluate haematological scoring system for the early diagnosis of neonatal sepsis.

Objectives

- Categorise the haematological findings according to Rodwell's Hematologic Scoring System.
- Correlate these hematologic parameters with blood culture and C- reactive protein.
- Identify the risk factors associated with neonatal sepsis.

Material and Methods

This was the hospital based observational study, conducted in Pathology Department with the Department of Paediatrics. The study population included 100 neonates less than 28 days old with clinical suspicion of sepsis. Thorough assessment of all neonates was done before they enrolled in the study. Research study lasted for 18 months, Neonates with known congenital abnormalities and receiving immunosuppressive therapy were excluded from study.

Methodology

After obtaining approval from the Institutional Ethical Committee, 100 neonates aged 0–28 days were selected based on predefined inclusion and exclusion criteria. Written informed consent was obtained from parents or legal guardians. Ethical transparency was ensured through clear communication regarding the study objectives, and the right to withdraw at any time without affecting the child's medical care. Each neonate underwent a detailed clinical examination, and the findings were documented using a predesigned and pre-validated proforma

Maternal Parameters: Age, Parity, prolonged rupture of membrane (>18 hr prior to delivery), maternal fever, APH, UTI, any other problems, and previous neonatal/ fetal death.

Perinatal Parameters: Including prolonged 2ndstage of labour (>1 h), fetal distress, meconium-stained liquor, multiple vaginal examination, instrumentation during delivery.

Neonatal Parameters: Gestational age, birth weight, APGAR score, clinical features (respiratory distress, feed intolerance, jaundice, diarrhoea, convulsions, necrotizing enterocolitis), gender.

Sample Collection

Blood samples were collected aseptically in EDTA vacutainers through peripheral venipuncture or heel prick (3 to 4 ml of blood). Complete blood counts were analyzed using a BC-760 five-part automated haematology analyzer. Calibration, standardization of the instrument, and processing of samples were performed according to the manufacturer's guidelines. Smears were prepared and stained with Modified – Leishman stain Differential leukocyte count was carried out by examining 200 cells. The peripheral smears were assessed for nucleated red blood cells, absolute neutrophil count, immature neutrophils. Degenerative morphological alterations in neutrophils, such as Döhle bodies, cytoplasmic vacuolation, and toxic granulation, were recorded. The haematological parameters were interpreted in accordance with the Haematological Scoring System described by Rodwell et al.

ISSN 2583-2069

Criteria	Abnormality	Score
Total WBC Count	≤ 5000/µI	1
	≥25000 at birth	1
	≥30000 at 12-24 hours	1
	≥ 21000 from day 2 onwards	1
Total PMN Count	No mature PMN seen	2
	Increased/decreased	1
Immature PMN Count	Increased	1
I:T PMN ratio	Increased	1
I:M PMN ratio	≥ 0.3	1
Degenerative changes PMN	Toxic granules/cytoplasmic vacuoles	1
Platelet Count	≤ 1.5 lakhs/µI	1

Rodwell et al's Hematological Scoring System[9]

"The normal values according to Manroe et al[10]:

Total PMN Count : 1800-5400 /mm^3

Immature PMN count : 600/mm^3

Immature: total PMN ratio =0.12

Immature: mature PMN ratio <0.3"

Interpretation of Hematological Scoring System

Score	Interpretation
≤ 2	Sepsis is unlikely
3 or 4	Sepsis is possible
≥ 5	sepsis or infection is very likely

C-reactive protein

Test was sensitised to detect levels of CRP greater than 6 µg/mL.

Blood culture

The BACT/ALERT® 3D-60 system was based on the colorimetric detection of carbon dioxide (CO_2) produced by microorganisms in specially formulated culture media bottles. The instrument continuously monitored this color change using reflected light and signalled positive results automatically, allowing early detection of microbial growth.

Result was interpretated as positive or negative depending on the growth.

Diagnostic Criteria for sepsis: Sepsis diagnosis was based on clinical signs, laboratory findings in HSS, and blood culture results.

Ethical Clearance

"The study was conducted in accordance with the protocol submitted and granted for ethics approval by the Institutional Ethical Committee. (IEC No. MMC/IEC/2024/369).

Statistical Analysis

Data were entered and analyzed using **SPSS version 26**. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation (SD).

Associations between sepsis categories and categorical variables were assessed using χ^2 tests with appropriate degrees of freedom. A p value < 0.05 was considered statistically significant.

Comparisons of continuous laboratory parameters across sepsis categories were carried out using one-way analysis of variance (ANOVA). Diagnostic performance of the Haematological Scoring System (HSS) was evaluated using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy, taking blood culture as the gold standard. Receiver Operating Characteristic (ROC) curve analysis was performed to assess the discriminative ability of HSS.

Results

Total 100 neonates aged 0–28 days admitted to the Neonatal Intensive Care Unit (NICU) with suspected or confirmed sepsis were included in the study.

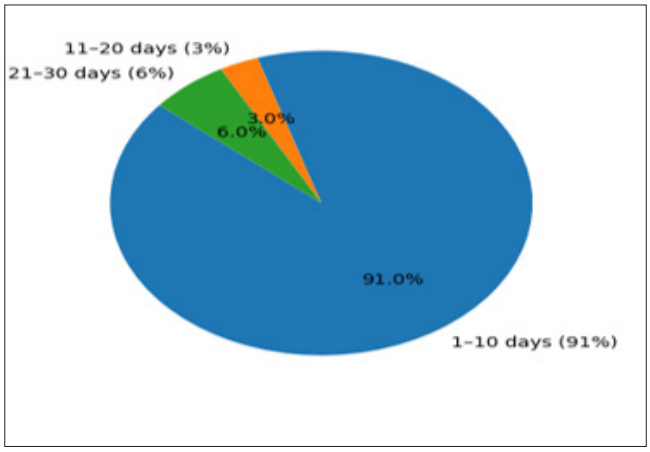


Figure 1. Distribution of age among the study participants (N=100)

The study population demonstrated a predominance of early neonatal age. Total 91% patients were aged between 1 and 10 days (figure 1).

The distribution of gestational age is depicted in Figure 2. Preterm neonates, constituted the majority of the study population, accounting for 64%. Term neonates, comprised 36% of the cases, indicating a marked predominance of preterm births (figure 2). The higher representation of preterm neonates highlights their increased susceptibility to morbidity and the likelihood of hospital admission.

Among the study population, poor feeding (66%) was the most common clinical presentation, followed by lethargy

(58%) and fever (50%), Respiratory distress (18%) was less frequent, while seizures (4%) were relatively rare.

Among the 100 neonates, 54% neonates were low birth weight, while 34% weighed between 2500 and 3499 grams. Very low birth weight neonates constituted 9% and only 3% neonates had a birth weight of 3500 grams or more. The mean birth weight of the study participants was 2.49 ± 1.22 grams.

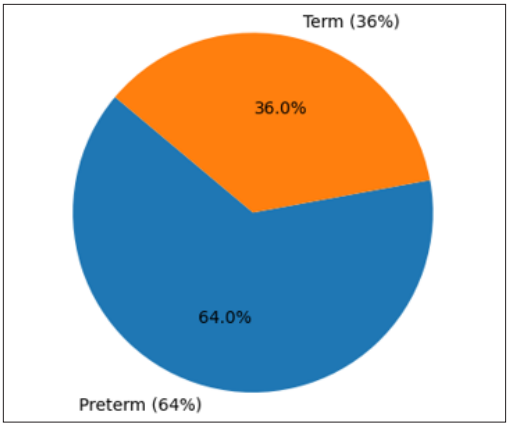


Figure 2. Distribution of gestational age among the study participants (N=100)

The distribution of Haematological Scoring System (HSS) in different sepsis categories is shown in the table. Among patients classified as sepsis very likely (n = 34), the majority had an HSS score ≥5, (32 patients ,94.1%), while only 2 patients (5.9%) had a score of 3–4. In the sepsis possible group (n = 31), most patients had an HSS score ≥5 (20 patients; 64.5%), followed by scores of 3–4 in 6 patients (19.4%) and scores of 0–2 in 5 patients (16.1%). Among patients categorized as sepsis unlikely (n = 35), majority (25 patient) had low HSS scores of 0–2, (71.4%). Scores of 3–4 were seen in 8 patients (22.9%), while only 2 patients (5.7%) had an HSS score ≥5. Overall, higher HSS scores were predominantly observed in patients with a higher likelihood of sepsis (Table 1).

In our present study, 67.7% of neonates in the sepsis very likely group had raised WBC counts (>20,000/µL). This high proportion underscores the role of total leukocyte count as an early marker of infection. Around 58.8% of neonates in the sepsis very likely group had ANC >5,400/µL, suggesting significant neutrophil mobilization from bone marrow stores. The immature PMN count (>600 cells/µL) was elevated in 70.6% of neonates in sepsis very likely group. This finding highlights enhanced bone marrow response to bacterial infection (Table 2).

Table 1: Distribution of Haematological Scoring System (HSS) in relation to sepsis interpretation (N = 100)

HSS Interpretation	Score 0–2 n (%)	Score 3–4 n (%)	Score ≥5 n (%)	Total
Sepsis very likely	0 (0.0)	2 (5.9)	32 (94.1)	34
Sepsis possible	5 (16.1)	6 (19.4)	20 (64.5)	31
Sepsis unlikely	25 (71.4)	8 (22.9)	2 (5.7)	35
Total	**30**	**16**	**54**	**100**

Table 2: Association of laboratory parameters with neonatal sepsis (N=100)

Variable	Total no. of patient	Sepsis very likely (n=34) No.(%)	Sepsis possible (n=31) No.(%)	Sepsis unlikely (n=35) No.(%)	P value
WBC (/µL)					
Decreased	13	6 (17.6)	2 (6.4)	5 (14.3)	0.001
Normal	34	5 (14.7)	9 (29.1)	20 (57.1)	
Raised	53	23 (67.7)	20 (64.5)	10 (28.6)	
ANC (/µL)					
<1800µL	13	8 (23.5)	4 (12.9)	1 (2.9)	0.022
1800-5,400 µL	32	6 (17.6)	9 (29)	17 (48.6)	
>5,400 µL	55	20 (58.8)	18 (58.1)	17 (48.6)	
Immature PMN Count (/µL)					
≤ 600 cells/µL	50	10 (29.4)	14 (45.2)	26 (74.3)	0.001
>600 cells/µL	50	24 (70.6)	17 (54.8)	9 (25.7)	
I/T Ratio					
<0.12	42	6 (17.6)	9 (29.0)	27 (77.1)	<0.001
≥ 0.12	58	28 (82.4)	22 (71.0)	8 (22.9)	
I/M Ratio					
<0.3	41	7 (20.6)	11 (35.5)	23 (65.7)	0.0012
≥ 0.3	59	27 (79.4)	20 (64.5)	12 (34.3)	

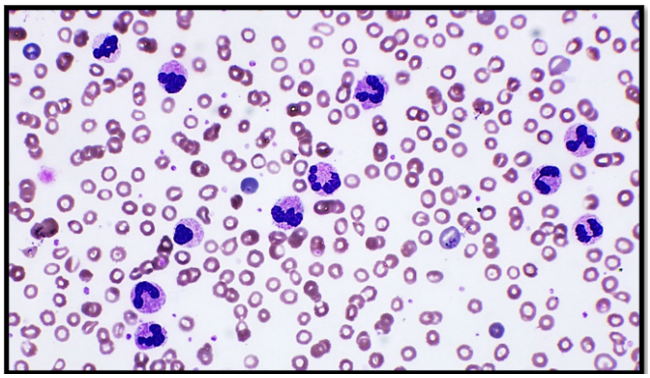
ISSN 2583-2069

Degenerative changes in PMNs Present Absent	 53 47	 26 (76.5) 8 (23.5)	 18 (58.1) 13 (41.9)	 9 (25.7) 26 (74.3)	 <0.001
Platelet Count (lakhs/µL) < 150,000 /µL. 150,000 – 450,000 /µL	 56 44	 24 (70.6) 10 (29.4)	 21 (67.7) 10 (32.3)	 11 (31.4) 24 (68.6)	 0.001

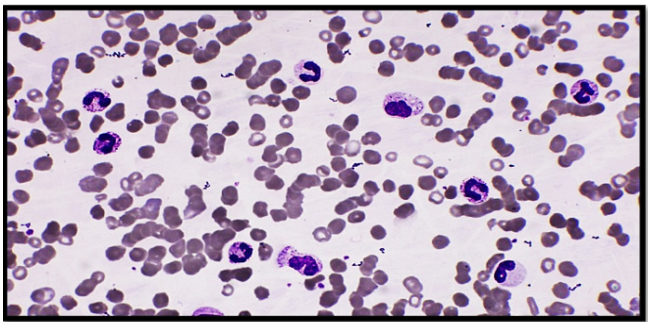
The I/T ratio (≥0.12**)** was present in 82.4% of neonates in the sepsis very likely group. Similarly, abnormalities in the I/M ratio (>0.3) were observed in 79.4% of neonates in sepsis very likely group, indicating significant disruption in neutrophil maturation dynamics (Table 2).

Degenerative changes in neutrophils-such as toxic granulation and cytoplasmic vacuolization-were present in 76.5% of neonates in sepsis very likely group**,** reflecting severe inflammatory stress and systemic toxicity (Table 2).

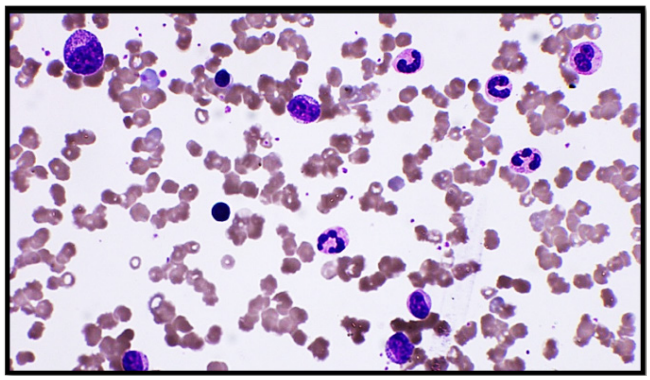
Thrombocytopenia was another major finding, with 70.6% of neonates in sepsis very likely group (Table 2).



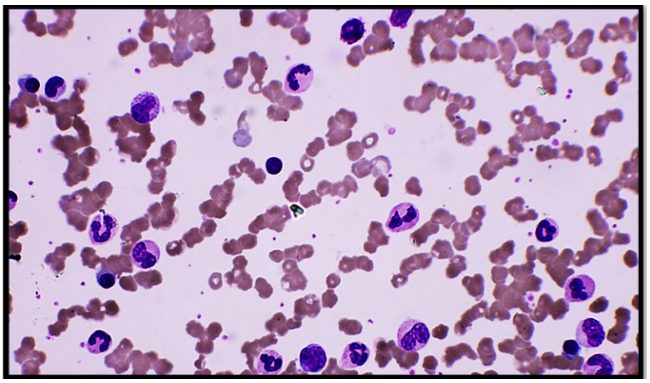
Photomicrograph of PBS showing leukocytosis with neutrophilia [Leishman stain ,200X].



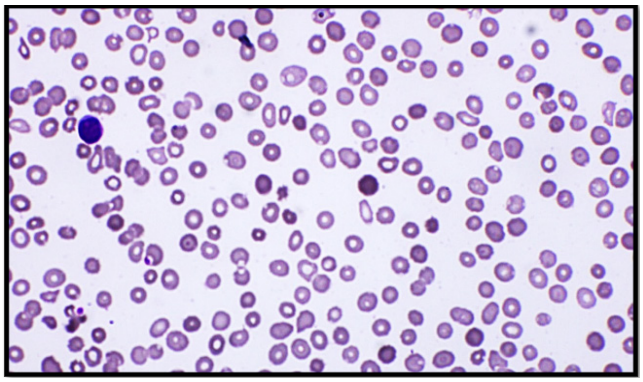
Photomicrograph of PBS showing neutrophilia with toxic granulation and cytoplasmic vacuolation [Leishman stain, 200X].



Photomicrograph of PBS showing shift to left (immature cells) [Leishman stain ,200X].



Photomicrograph of PBS showing shift to left (immature cells) with nucleated red blood cells [Leishman stain ,200X].



Photomicrograph of PBS showing thrombocytopenia with leukopenia [Leishman stain, 200X]

Table 3: Association of different categories of neonatal sepsis with major risk factors (N=100)

Variable	Total number of patients	Sepsis very likely (n=34)	Sepsis possible (n=31)	Sepsis unlikely (n=35)	X^2 (df), p
Gestational age in weeks					
Pre term	64	26 (76.5)	20 (64.5)	18 (51.4)	6.84 (2), 0.033
Term	36	8 (23.5)	11 (35.5)	17 (48.6)	
Birth weight					
<1500	9	6 (17.6)	2 (6.5)	1 (2.9)	13.12 (6), 0.04
1500-2499	54	20 (58.8)	18 (58.1)	16 (45.7)	
2500-3499	34	8 (23.5)	9 (29)	17 (48.6)	
≥3500	3	0 (0)	2 (6.5)	1 (2.9)	
Place of delivery					
Hospital delivery	70	18 (52.9)	24 (77.4)	28 (80)	8.92 (2), 0.02
Home delivery	30	16 (47.1)	7 (22.6)	7 (20)	
CRP					
Positive	78	31 (91.2)	20 (64.5)	27 (77.1)	6.74 (2), 0.03
Negative	22	3 (8.8)	11 (35.5)	8 (22.9)	
Blood culture					
Positive	52	20 (58.8)	10 (32.2)	22 (62.9)	7.12 (2), 0.02
Negative	48	14 (41.2)	21 (67.8)	13 (37.1)	

Table 4: Diagnostic accuracy of Haematological Scoring System (N=100)

Haematological score	Culture		Total
	Positive	Negative	
≥ 5	46	8	54
<5	6	40	46
Total	**52**	**48**	**100**

Score	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
≥ 5	88.5%	83.3%	85.2%	86.9%

Table 3, depicts the association between different categories of neonatal sepsis and various risk factors. The distribution of neonates across 3 sepsis categories is analyzed, along with the corresponding Chi-square values and p-values to assess statistical significance. A majority of neonates (91%) were aged between 1–10 days. No statistically significant association was observed between age group and sepsis status ($\chi^2 = 3.08$, df = 4, p = 0.54). Similarly, gender distribution showed no significant association with sepsis, ($\chi^2 = 1.49$, df = 2, p = 0.47). Gestational age showed a statistically significant association with sepsis ($\chi^2 = 6.84$, df = 2, p = 0.033). Preterm neonates formed a higher proportion in the sepsis very likely group (76.5%) compared to term neonates. No statistically significant association was noted between clinical presentation and sepsis status ($\chi^2 = 3.75$, df = 8, p = 0.88). Birth weight demonstrated a significant association with sepsis ($\chi^2 = 13.12$, df = 6, p = 0.04). Neonates with lower birth weights were more frequently observed in the sepsis very likely group compared to those with normal or higher birth weights. No statistically significant association was found between mode of delivery and sepsis status ($\chi^2 = 2.04$, df = 2, p = 0.36). Place of delivery demonstrated a significant association with sepsis status ($\chi^2 = 8.92$, df = 2, p = 0.02).

CRP positivity showed a statistically significant association with sepsis ($\chi^2 = 6.74$, df = 2, p = 0.03), with a higher proportion of CRP-positive cases observed in the sepsis very likely group.

Blood culture results also showed a statistically significant association with sepsis ($\chi^2 = 7.12$, df = 2, p = 0.02), with culture positivity being more frequent in the sepsis very likely category.

Of the 52 culture-positive cases, 46 patients had a haematological score ≥5, while 6 patients had a score <5. Among the 48 culture-negative cases, 40 patients had a haematological score <5, whereas 8 patients had a score ≥5 (Table 4).

Using blood culture as the gold standard, the haematological scoring system demonstrated a sensitivity of 88.5%, specificity of 83.3%, positive predictive value of 85.2%, and negative predictive value of 86.9%. The overall diagnostic

ISSN 2583-2069

accuracy of the haematological scoring system was 86%. These findings indicate that a haematological score ≥5 is a reliable indicator for the diagnosis of neonatal sepsis in the study population. (Tab. 4)

ROC Curve

The ROC curve demonstrates the diagnostic performance of the haematological scoring system (HSS) in identifying neonatal sepsis using blood culture as the gold standard. The curve lies well above the line of no discrimination, indicating good diagnostic ability. At the cut-off value of HSS ≥5, the test shows high sensitivity (88.5%) and good specificity (83.3%). The steep rise toward the upper-left corner reflects a high true-positive rate with relatively few false positives. Overall, the ROC analysis supports HSS as a reliable screening tool for neonatal sepsis.

Discussion

Neonatal sepsis is a clinical syndrome, consisting of bacteremia with varied clinical features resulting due to the chemicals released by the microbes. Study provides a comprehensive evaluation of demographic characteristics, perinatal risk factors, clinical features, laboratory parameters, blood culture results, and the diagnostic utility of Rodwell's Hematological Scoring System (HSS) in neonatal sepsis.

In the present study, a marked predominance, of early neonatal age was noted with a mean age of 4.31 ± 6.46 days. Clustering in the early neonatal period is indicative of early-onset neonatal sepsis. Comparable findings have been documented in earlier studies. Sudhir Prabhu et al[11]. reported that 71.5 % of neonated presented within 72 hrs of life. Similarly, Chotaliya et al[12]. & Bharuwal et al[13] reported that 85% of neonates presented in early neonatal period

In the present study, preterm neonates constituted 64% of the study population. The heightened susceptibility of preterm infants can be attributed to immature immune defenses, and compromised skin and mucosal barriers.

Comparable findings were observed by Saleem et al[14]. and Makkar et al[15],Pramana et al.[16] , supporting the consistent trend of higher sepsis occurrence among preterm infants.

Shalini et al[17] and Saeed et al[18] demonstrated a mild preterm neonates predominance.

Poor feeding (66%) was the most common presenting complaint, markedly higher than that reported by Saeed et al.[18] (13.8%), Sudhir Prabhu et al.[11] (16.5%) and Bharuwal et al[13] (50.3%). This suggests that feeding intolerance remains a prominent early warning sign in our cohort. Saleem et al[14] reported poor feeding in 66.5% neonates in their study.

In the present study, 63% of neonates weighed <2500 g, while 37% weighed ≥2500 g, demonstrating significant LBW burden. This finding reinforces that neonates with lower birth weights are more vulnerable due to immune immaturity, impaired complement activity, and poor thermoregulation. An even higher prevalence was reported by Saleem et al[14], who documented 67.5% VLBW neonates,

Haematological Scoring System

Distribution of neonates across sepsis probability categories showed a relatively balanced pattern, with 34% classified as "sepsis very likely," 31% as "sepsis possible," and 35% as "sepsis unlikely." A comparable observation was seen in Makkar et al[15]., where 42% were categorized as sepsis very likely, 22% as possible, and 46% as unlikely.

Statistically significant increase in total leukocyte count, absolute neutrophil count, immature PMN count, I/T ratio, I/M ratio and degenerative changes was observed from the sepsis unlikely group to the sepsis very likely group. These findings strongly support intense bone marrow response and systemic inflammation.

In the present study, 67.7% of neonates had raised WBC count and this finding was highly significant in association with sepsis; importantly, this percentage specifically pertains to neonates categorized under the "sepsis very likely" group. In contrast, Saleem et al.[14] reported that 47.5% of neonates had raised WBC count.

Present study, 58.8% of neonates had ANC >5,400/µL, demonstrating a strong association with sepsis. This proportion was specifically observed among neonates classified under the sepsis very likely group. Comparable findings were observed by Bharuwal et al[13], where 61.2% of neonates exhibited elevated ANC. Similar findings were observed by Kushwaha et al.[19] In our study, 70.6% of neonates in the sepsis very likely group had raised immature PMN count (>600 cells/µL). Kushwaha R et al.[19], Krishnamurthy et al[20] and Khair et al[21] also reported an increase in immature polymorphonuclear cells count (band forms). In the present study, I/T ratio ≥0.12 was observed in 82.4% of neonates, demonstrating a strong discriminatory value for sepsis. Comparable findings were reported by Kushwaha et al.[19], who found that 74.5% of neonates met this criterion, with a statistically significant association with sepsis.

Majority, (79.4%) of neonates with severe sepsis demonstrated an I/M ratio >0.3, and this finding showed a statistically significant association. Comparable findings were observed by Pramana et al.[16], who reported that 62.9% of neonates had an I/M ratio ≥0.3, with significant diagnostic relevance. Degenerative changes was observed in 53% of neonates. An higher proportion was reported by Bharuwal et al[13] who observed 57.1% of neonates with degenerative changes

In the present study, 70.6% of neonates with severe sepsis had low platelet counts, demonstrating a highly significant association with sepsis severity. A higher prevalence was

reported by Saleem et al[14], where 75.6% of neonates had platelet counts ≤150,000/mm³, showing significant association.

Rodwell's Hematological Scoring System proved to be a reliable diagnostic tool in the present study. Using a cutoff score of ≥5, the HSS demonstrated high sensitivity (85.2%), specificity (83.3%), and overall diagnostic accuracy. Higher HSS scores were strongly associated with increased sepsis probability. The Modified HSS demonstrated a positive predictive value (PPV) of and negative predictive value (NPV) of 86.9%. The markedly high specificity indicates that the scoring system was highly reliable in ruling out non-septic neonates, although sensitivity was comparatively moderate.

In comparison, Shalini et al.[17] reported a sensitivity of 68% and specificity of 61%, with nucleated RBC identified as the marker contributing the highest sensitivity. Kaur et al.[22] demonstrated improved diagnostic performance, with sensitivity of 75.6% and specificity of 88.1%. Their PPV (82.93%) and NPV (82.54%) were balanced, and platelet indices were identified as the most sensitive marker. Similarly, Saeed et al.[18] reported sensitivity of 84.21% and specificity of 75.41%, with an NPV of 93.88%. Nucleated RBC emerged as the highest sensitivity marker in their study. Similar finding were also observed by Krishnamurthy et al.[20] The best overall performance among the compared studies was observed by Bharuwal et al.[13], who reported sensitivity of 90.48% and specificity of 96.83%, along with very high NPV (98.38%). This suggests excellent diagnostic discrimination in their cohort.

When compared with other studies evaluating modified HSS, the present study demonstrated comparable or superior specificity (83.3%) and positive predictive value (85.2%). The high specificity observed in the present study supports its usefulness in confirming sepsis and guiding clinical decision-making. Although sensitivity was slightly lower than that reported in some modified HSS studies, specificity and positive predictive value were notably high, reinforcing the role of HSS as a practical and cost-effective screening tool, particularly in resource-limited settings.

Conclusion and Recommendation

"Our study highlights the usefulness of Rodwell's hematological scoring system as a cost-effective and practical tool in the early diagnosis of neonatal sepsis. It also emphasizes that while CRP and blood culture remain important supportive investigations, hematological parameters like immature PMN count, I/T and I/M ratios, and platelet count provide valuable diagnostic insights. The observed association between higher sepsis probability and neurodevelopmental risk underscores the importance of early diagnosis and intervention. Future studies with larger sample sizes and follow-up into infancy are recommended to validate these findings and assess long-term outcomes."

We recommend that Rodwell's hematological scoring system be incorporated into routine neonatal sepsis screening protocols, particularly in resource-limited settings where rapid and affordable diagnostic tools are essential**.** Hematological markers should be interpreted in combination rather than isolation to improve diagnostic accuracy and early risk stratification. Strengthening early screening, close monitoring of high-risk neonates, and prompt initiation of therapy may help reduce morbidity and potential long-term complications. "Future studies with larger sample sizes and structured follow-up into infancy are recommended to validate these findings and to better assess long-term neurodevelopmental outcomes."

Conflicts of interest

The authors declare that they do not have conflict of interest.

Funding

No funding was received for conducting this study.

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